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ABSTRACT

An easy-to-use plan that offers the accuracy and objectivity of statistics without the complexities is described. The plan is an adaptation of a general statistical procedure called the Median Test. The 10-step computation of the Median Test is given. An appendix discusses the "median." (DB)

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RESEARCH MEMORANDUM

TO: Faculty and Staff
SUBJECT: Is it really a better technique?*

Armchair 'analysis' can give you answers to student learning questions which may-- or may not, be factually accurate. On the other hand, those who wish to formulate answers that can be tested for accuracy can make such determinations without being 'experts' in educational experimental design or statistics, and without relying on subjective evaluations and hunches. It is the purpose of this document to describe an easy-to-use plan that offers the accuracy and objectivity of statistics without the complexities.

Basically, research records observations. Usually these observations are focussed on one "variable", and by controlling the situation in which this variable operates, the researcher can feel some confidence in interpreting his findings and making generalizations. However, among educational researchers this is often a most difficult problem for rarely can he control the teaching-learning situation.

A most useful means for achieving the effect of control without actually exerting direct control is the experimental design of "control group vs. experimental group". In this technique the researcher utilizes two highly similar groups—one in which the experimental variable is present (or active) and one in which it is not.

Typical experimental variables in educational research are innovative classroom-related procedures (such as independent study), experimental textbooks (such as programmed texts), and new groupings of students (such as dormitory roommates). In research parlance, the experimental groups are said to have received a "treatment" and the task of the researcher is to evaluate the effects of such "treatments".

To impose objectivity on the observations made by the researcher he usually applies some sort of standard measure to the behavior of the two groups, i. e., the 'control' and the 'experimental' groups. This measure is frequently an examination, and if the experimental or 'treatment' group performs "better" than the control or untreated group, the "treatment" technique, innovation, or experiment is considered 'successful'.

The instructor who thinks that scolding students about grades is harmful can test his hypothesis with verbal chastisement as the experimental variable (or "treatment"). The political science instructor can check the effects of her efforts to get students to use the library by comparing those who receive the "treatment" with those who do not. The teacher who hypothesizes that his more mature evening division students are "better" than his day students can observe how the variable of maturity (a 'natural' treatment factor) affects students' behavior on examinations.

If the measured performance of the control and experimental groups is vastly different the researcher can generally conclude that the variable he is studying is indeed effective. But often results are not "vastly" different. What then?

*Adapted from ERIC Topical Paper, No. 6, March 1969, (Aiken Connor), Clearinghouse for Junior Colleges UCLA.

One way to resolve such doubts is to repeat the experiment or research again and again with different students. However, often such replication is impractical or impossible, in which case the researcher can employ appropriate statistical procedures that offer substantially the same assurance of the reliability of his observations without the need to repeat the research.

The critical question statistics will answer is "What are the chances of getting similar results if the experiment is repeated?" Usually, educational researchers will accept results whose probabilities of being repeated are 95 out of 100. This is termed the so-called ".05 level of confidence" or as some prefer, the ".05 level of significance".

Most statistical tests are designed to test the hypothesis that the 'control' and 'experimental' groups are actually subgroups of the same population. If the probability of both being from the same population is 5% or less, the "treatment" or variable being researched is assumed to be responsible. In other words — if the level of confidence is 95 or more probabilities (or 'chances') out of 100 that repeating the experiment will yield the same results, the hypothesis is then rejected that the 'control' and 'experimental' groups are not parts of the same larger group (or population). Under these conditions, it is then concluded, with a high level of statistical probability, that the measured difference between the "treatment" and control groups is, in fact, a real difference, and not merely a chance variation which might have occurred because of sampling fluctuations alone and not necessarily because of the "treatment" given to the experimental group.

An easy method of determining the reliability of measured group comparisons is the following adaptation of a general statistical procedure called the Median Test. Two important factors favor the Median Test for group comparisons: (1) it is easy to compute, and (2) it requires only two basic assumptions — that both groups are compared by the same measure, and that the two groups are, in fact, separate groups, not the same group measured before and after a treatment.

Drawing from a real life example, the following is a step by step computation. A junior college philosophy professor (Dr. Lawrence A. Wenzel, while teaching at Yuba College) had heard his colleagues talk of the efficiency of tongue-lashing on student's grades, but had not heard of empirical data — only opinions. He hypothesized that scolding students about grades is harmful and he tested his hypothesis with verbal chastisement as the experimental variable. One semester when he had two sections of an introductory course in philosophy that appeared to be comparable in ability, he contrived a situation (the "treatment" group) wherein he berated the students after each test to "shape up or ship out". His final comparison of the groups was the course-end exam: the scores follow:

<u>Control Class</u>		<u>Experimental Class</u>	
98	87	95	74
95	86	90	72
94	84	87	70
92	80	85	68
90	80 — Median	80 — Median	65
90	78	78	60
88	75	76	58
88	71	74	57
	68		50

A "short-cut" method to determine if a significant difference exists between the two groups is:

(1) Find the median for both groups combined (Directions for determining medians are given in Appendix A.)

(2) In Table 1 below find the number of cases in the experimental group above the median necessary to achieve a significant difference. (Directions for use of Table 1 are given beneath it.)

(3) NOTE:- If the number of scores of the two groups combined above the median is different from the number below the median by more than one, Table 1 cannot be used. In this relatively rare instance, it will be necessary to make the 10-step computations as described below. (This is the case for the example here cited, for the difference between the above median and below median groups is $18-16=2$)

TABLE 1

	Number in Control Group										
	10	11	12	13	14	15	16	17	18	19	20
10	8	8	8	8	8	8	8	8	8	8	8
11	8	8	9	9	9	9	9	9	9	9	9
12	9	9	9	9	9	9	9	9	9	9	9
13	10	10	10	10	10	10	10	10	10	10	10
14	10	10	10	10	10	10	10	10	10	11	10
15	11	11	11	11	11	11	11	11	11	11	11
16	11	11	11	11	11	11	11	11	11	12	11
17	12	12	12	12	12	12	12	12	12	12	12
18	12	12	12	12	12	12	12	12	12	13	13
19	13	13	13	13	13	13	13	13	13	13	13
20	13	13	13	13	13	13	13	13	13	14	14

Find the total in the experimental group in the vertical column; follow across to the number in the control group. Number in the intersection is the number required in the experimental group above the median for significant difference; i.e. at the 5% level of confidence that the difference between the experimental and control groups is a real difference, and not a 'sport' variation.

10 Step Computation of Median Test:-

- STEP 1. Find the median for both groups combined (Directions for determining medians are given in Appendix A)
Median of combined groups = (79.83)
- STEP 2. Find the difference between the number of scores in the experimental group above the combined median and the number below. (7 for this group) If there are fewer above the median than below, there is no need to continue - the treatment was not successful. (In this example there are 18 above and 16 below - therefore continue to next step.)
- STEP 3. Repeat Step 2 for Control group. (9 for this group) (Bear in mind - his hypothesis was that the experimental group would perform less well than the control group).
- STEP 4. Find the average difference, using both groups. (Number from Step 2 plus number from Step 3, divided by 2 (8 for this example)).
- STEP 5. If the number of scores above or below the median in either group is fewer than 10, subtract 1 from the average difference which you determined in Step 4. (In this example, since the number of scores above the median in the experimental group is less than 10, you subtract 1 from the average difference — or 7)
- STEP 6. Square the difference found in Step 5 (or Step 4, if Step 5 is skipped). 49 for this example.
- STEP 7. Divide the number in Step 6 by the number of scores in the experimental group above the median plus the number below ($49 \div 17 = 2.88$)
- STEP 8. Divide the number in the experimental group (those above the median plus those below) by the number in the control group above the median plus the number below ($17 \div 17 = 1$)
- STEP 9. Multiply the number from Step 7 (2.88) by the number from Step 8 (1) plus 1 (or 2). ($2 \times 2.88 = 5.76$)
- STEP 10. If the number from Step 9 is greater than 2.71 * the two groups may be presumed to be significantly different — the "treatment" was a success.
- (* To those curious about the 2.71 — it is the size of the Chi-square necessary to reject the null hypothesis in a one-tailed test, with one-degree of freedom, at the .05 level of confidence!)

APPENDIX A

The median is a point (on the same scale used to measure the group) that divides the upper half of the scores from the lower half. Each score is assumed to be the midpoint of a "score interval". For example, a score of 8 is the midpoint of the score interval 7.5 — 8.5; a score of 123 is the midpoint of the score interval 122.5 — 123.5, etc.

To find the median if the total number of scores is odd:

1. Arrange scores in order, low to high.
2. Subtract 1 from the total number of scores and divide remainder by 2.
3. From the lowest score, count until the number from Step 2 is reached.
4. Median is the next score above.

Example:- Scores = 1, 3, 5, 9, 11 or $N=5$

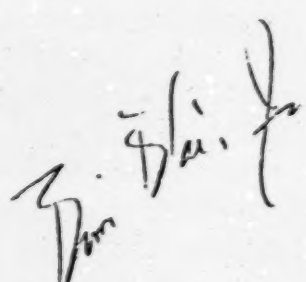
$5-1=4$; $4/2 = 2$; score of 3 is the 2nd score; score of 5 (the next score above) is the median ($Mdn=5$)

To find the median if the total number in the group is even:

1. Arrange scores in order, low to high
2. From the lowest score, count upward until half the scores are counted.
3. The median will be a point halfway into the interval between the highest point of the score interval represented by the top score in the lower half, and the lowest point of the score interval represented by the lowest score in the upper half.

Example:- Scores = 1, 2, 3, 5, 8, 8, 10, 11 or $N=8$

Median is located halfway between 5.5 (the upper limit of the highest score interval in the lower half), and 7.5 (the lower limit of the lowest score interval in the upper half). Thus the median is $(5.5 + 7.5) / 2 = 6.5$.



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